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(56) Documents Cited

GB 0389334 A US 5518476 A US 4771548 A
US 4452447 A

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(54) Foot joint position determination

(57) A goniometric measuring device to quantify the frontal plane angular relationship in the closed chain (weightbearing) scenario, of the rearfoot to ground, ground to lower leg and forefoot to rearfoot, whilst maintaining the subtalar joint in the neutral position. The device comprises frame base 1, and foot support plate 2 pivotable about pivot bar 5. This arrangement can be locked in the desired position by use of locking nut arrangement 6 and the angular values read off from a measurement scale 7 calibrated to be level with the ground via an integral spirit level 10. An optional modification is a support plate having a front portion movable relative to a rear portion to allow additional forefoot to rearfoot evaluation.

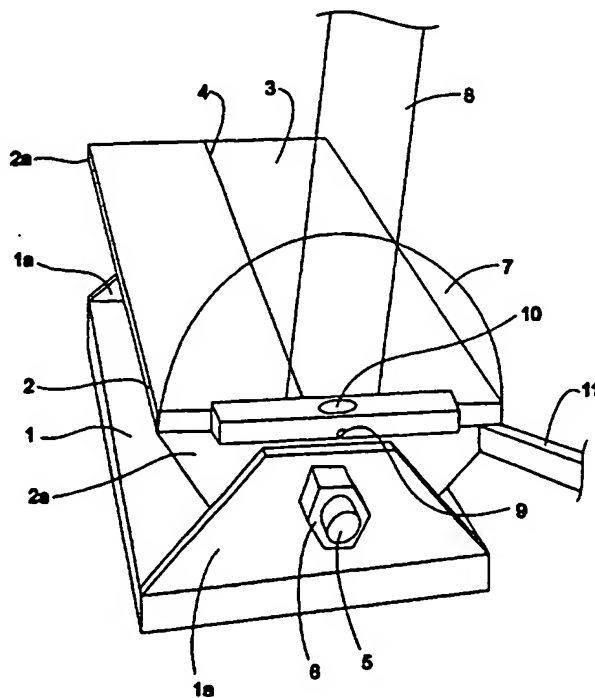


Figure 1

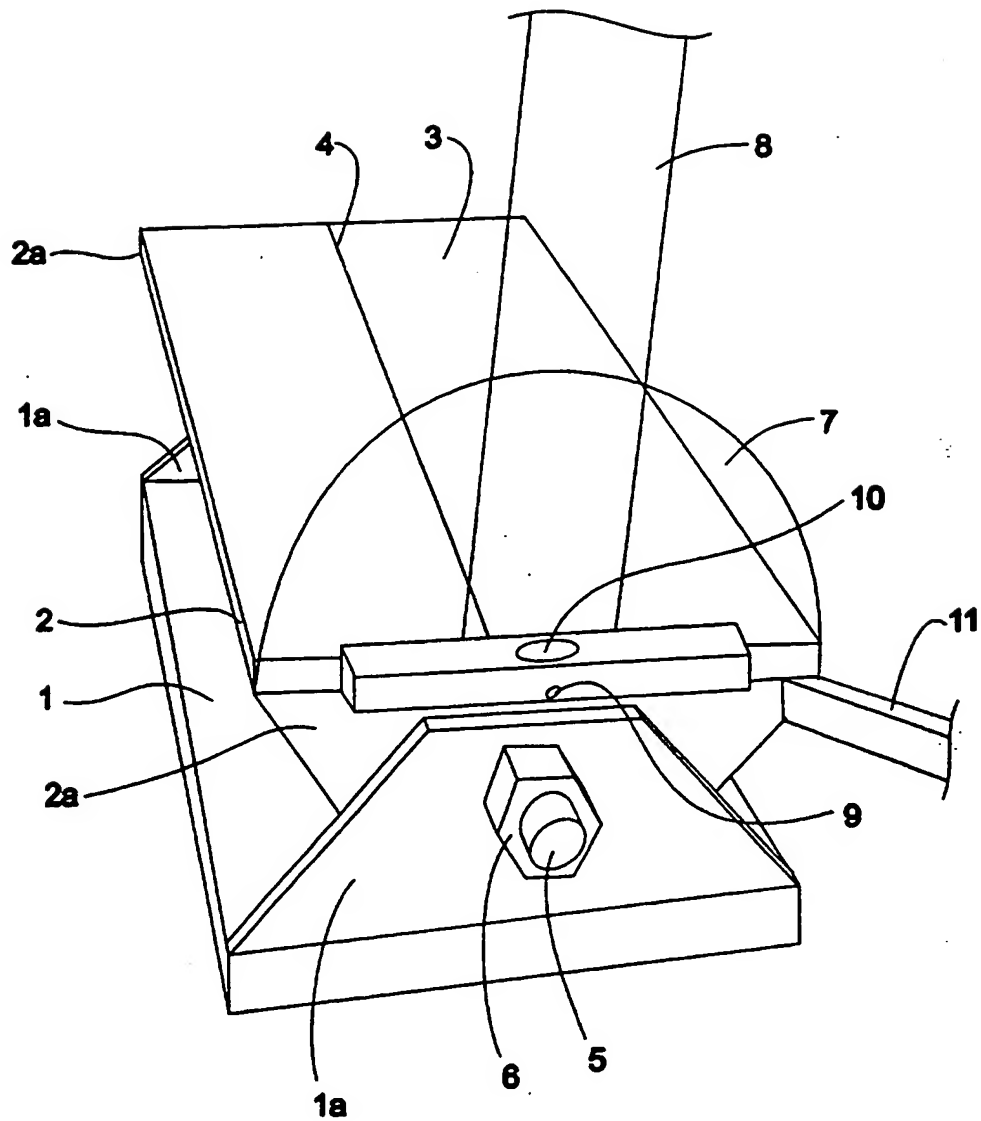


Figure 1

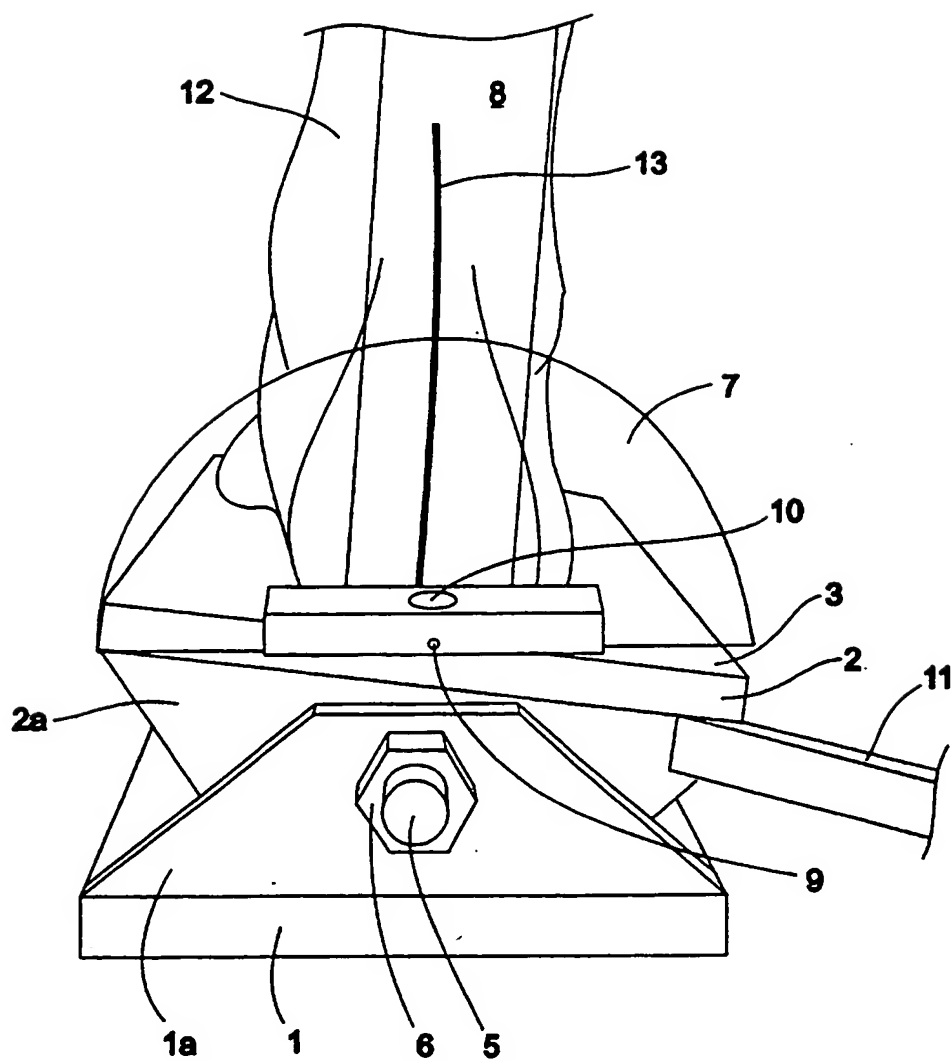


Figure 2

Apparatus for Use in Determining Foot Joint Position

This invention relates to apparatus for use in determining foot joint position. The apparatus is particularly, but not exclusively, intended for use in determining subtalar neutral joint position for prescribing corrective insoles to be worn inside the shoe by a patient with biomechanical pathology causing morbidity within the foot.

Such insoles, known as orthoses, facilitate rigidity within the forefoot during gait by controlling excess pronation of the foot. This excess pronation (in-rolling, 'fallen arches') causes hypermobility within the foot at a time in the gait cycle when the foot should be a rigid lever. Pathologic sequelae without provision of orthoses are numerous and debilitating over time. In the short term plantar callosities, corns, plantar fasciitis, tendonitis, soft tissue strains may progress to bunions, claw/hammer toe deformities and eventually osteoarthritic degenerative changes.

Orthoses are typically in the form of thermoplastic shells moulded to a positive plaster cast of the foot, the cast taken from the foot in the subtalar joint neutral position, i.e. the position of maximal talar-calcaneal congruency. The orthoses are then canted with acrylic or high density EVA posting on the rear and/or forefoot area (just proximal to the ball of the foot) so as to facilitate efficient foot function in gait about the neutral position.

Traditionally subtalar joint neutral position is clinically determined in a weightbearing and/or non-weightbearing condition by palpation of the talar head for navicular congruence just anterior to the ankle joint.

The traditional weightbearing evaluation of subtalar joint neutral position requires the patient actively to elevate (or uncommonly, to lower) the instep (arch) of the foot and then to maintain this position without ground support under the medial forefoot area during palpation.

The present invention arises from a desire to obviate active patient muscular contraction during weightbearing evaluation of the subtalar joint neutral position, by use of a method which maintains load on the forefoot area.

According to the present invention, apparatus for use in determining foot joint position comprises support means for supporting the foot, the support means being adjustable to change at least one joint angle of the foot whilst the foot is maintained in a loaded condition.

Preferably the support means comprises a pivotable platform.

The apparatus is preferably provided with a handle for adjusting the support means.

Preferably fixing means should be provided for retaining the support means in position after adjustment. In a convenient arrangement, a bar serves as a pivot for the support means, and the fixing means for retaining the support means in position comprises a locking nut on the bar.

Preferably the apparatus is provided with means for measuring joint angle, which may conveniently comprise a protractor.

The apparatus may advantageously be provided with a protractor which is movable relative to the support means, and which is provided with an integral levelling device, such as a spirit level, to enable it to be set in a fixed relationship with respect to the horizontal. Use of the protractor may be facilitated by provision of an aligning device, such as a pointer or a rule, which may be aligned with part of the foot or leg, and which has a reference point, such as a mark or an edge, which indicates the angle of the foot or leg part against the angular scale of the protractor.

In a convenient arrangement, the aligning device comprises a rule, both rule and protractor being pivotable about the centre of the protractor (i.e. a point on the face of the protractor at or proximal the mid-point along its straight edge), both rule and protractor comprising transparent material to enable the foot and/or leg to be viewed therethrough.

Marking on the support means is preferably provided to show where the foot is to be placed in use of the apparatus.

Preferably a front portion of the support means is movable relative to a rear portion of the support means to allow independent positioning of the front and rear of the foot, a scale most preferably being provided to show the angle between the front and rear portion of the support means in order to permit additional forefoot to rearfoot evaluation.

The apparatus may desirably be made radiolucent to facilitate x-radiographic examination of the foot.

To enable plaster casts to be produced of the foot whilst the foot is on the support means, retaining means is preferably provided to limit movement of the foot and casting materials. The retaining means may conveniently comprise barrier means, or may advantageously comprise resilient means on the support means which compresses under load to provide a cradle for retaining the foot and casting materials.

By way of example only, apparatus comprising a specific embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of the apparatus, showing the support means disposed horizontally;

Figure 2 is a diagrammatic illustration of the apparatus in use, in which the support means is disposed at an angle to the horizontal.

Referring to the drawings, the apparatus comprises a steel base plate 1 and a steel foot support plate 2 which is provided with a rubber tread mat adhered to its upper surface 3. A centre line 4 is also marked on the upper surface 3 of foot support plate 2.

As best shown in figure 1, the foot support plate 2 is pivotable relative to the base plate 1 about a steel pivot bar 5, the axis of which is parallel to centre line 4. Pivot bar 5 passes through pairs of steel flanges 1a on the base plate 1 and 2a on the foot support plate 2. (One of flanges 2a, located at the far end of support plate 2, is concealed in the drawing.)

For locking the foot support plate 2 in fixed angular relationship to the base plate 1 at least one locking nut 6 is provided on pivot bar 5.

A protractor 7 and rule 8 are provided at the end of the foot support plate adjacent to where the heel of the foot is normally placed. Both protractor and rule 8 are formed of transparent material and are pivotable about a common pivot pin 9, the axis of which is located at the centre of the protractor parallel to centre line 4. A locking nut (not shown) may be provided on pivot pin 9 to hold the protractor and rule in position, or the pivot may be formed with sufficient friction to prevent inadvertent movement of the rule and protractor.

To enable the protractor to be levelled, it is provided with an integral spirit level, 10.

A handle, 11 is joined to foot support plate 2 to enable its angular position to be adjusted in use.

The apparatus is approximately 110 mm high (measured to the upper surface 3 of the foot support plate 2), 350 mm long (measured parallel to centre line 4) and 140 mm wide. The foot support plate 2 is formed of 8 mm thick steel, and the base may be formed of similar material. Pivot bar 5 is 20 mm in diameter. Handle 11 is 120 mm long and of 12 mm section, and rule 8 is 460 mm long. Metal parts are matt high temperature spray paint finished.

Operation may be facilitated by replacing the standard locking nuts with butterfly nuts

For evaluation of subtalar joint neutral position, a posterior calcaneal bisection line is marked on the skin of the heel using an ink pen, a mid posterior leg longitudinal skin bisection line is similarly marked on the leg. The subject then adopts a standing position with the feet at their usual angle and base of gait, and (as illustrated in figure 2) the foot 12 to be assessed being placed on the foot support plate 2 with the heel bisector 13 and 2nd/3rd interdigital space being aligned directly above centre line 4. The other foot may be placed on a similar apparatus, or a wooden block of the same height.

Lock nut 6 is then slackened, and the frontal plane angulation of the foot support plate 2 is adjusted by means of handle 11 until subtalar neutral joint position is palpated, when the lock nut 6 is tightened once again.

The rule 8 is then aligned in turn with the heel bisector 13 and the leg bisector (not shown), and their angles relative to the horizontal read off where a central marker on the rule intersects the protractor scale. The protractor is levelled for each reading by means of the spirit level 10.

For contralateral limb readings the apparatus may be used for each foot in turn.

The device gives readings more comparable to 'real life' since it obviates active muscular contraction in achieving the subtalar joint neutral position by maintaining a load to the forefoot, which is a component of body weight transmitted through the lower limb joints.

Preliminary research shows that this embodiment of the invention enables an accurate, reproducible measurement of subtalar joint neutral position to be made when used in conjunction with goniometric bisection protocol widely employed in clinical biomechanical evaluation, and that this measurement has a different value to that given for the subtalar neutral position by the traditional weightbearing method.

For making plaster casts of the foot whilst on the support plate, an alternative embodiment of the invention may be provided with a barrier for retaining the foot and casting materials the barrier comprising a wall around the area occupied by the foot on the support plate.

In another embodiment, a layer of compressible polymer material is provided on the support plate, the layer being deformed by the foot and casting materials and thereby forming a cradle for retaining them.

In a further preferred embodiment of the invention, front and rear portions of the plate are independently pivotable to permit evaluation of the foot along the cyma-line, a scale being provided for determining the angle between the front and rear portions.

Claims

1. A goniometric device to measure subtalar joint neutral foot position passively in the closed chain (weightbearing) position. Consisting of a frame supporting a plate on which the foot is stood. This plate pivots in the frontal plane, can be secured at the desired angle and this angular excursion read-off in degrees using integral scale.
2. A goniometric device as claimed in Claim 1 to include a measurement arm to measure the angle of the lower leg as well as the posterior foot in the frontal plane.
3. A goniometric device as claimed in Claim 1 whereby the distal support plate may be independently varied in the frontal plane from the proximal support plate, and the angular discrepancy between subtalar joint and midtarsal joint quantified using integral measuring scale.
4. A goniometric device as claimed in Claim 3 whereby the support plate may have optional material types at the foot interface to enable plaster of Paris foot casts to be made in situ.
5. A goniometric device as claimed in any preceding claim which is made from metal, plastics material or wood, or from a combination of these.
6. A goniometric device as claimed in any preceding claim which may be adjusted in the sagittal plane additionally by the means of distal screws to measure the angle of ankle joint dorsiflexion and this excursion read off from an integral measurement scale.
7. A goniometric device substantially as herein described illustrated in Figure 1 page 5.



The Patent Office

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Examiner: Michael Walker
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Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G1X

Int Cl (Ed.6): A43D 1/02; A61B 5/103, 5/107; A61F 5/00, 5/14; A63B 23/08

Other: On-line : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 0389334 (MENTOR--) the drawing	1,5
X,Y	US 5518476 (MCLEON) abstract; col.11.32-40	X:1,5,6 Y:2
Y	US 4771548 (DONNERY) figs.2,3	2
X	US 4452447 (LEPLEY et al.) fig.1	1 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

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A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.

E Patent document published on or after, but with priority date earlier than, the filing date of this application.